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Carbon input and partitioning in subsoil by chicory and alfalfa

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Abstract

© 2016, Springer International Publishing Switzerland.Background and Aims: Input of organic matter into soil creates microbial hotspots. Due to the low organic matter content in subsoil, microbial hotspots can improve nutrient availability to plants. Therefore, carbon (C) input of root biomass and rhizodeposition and the microbial utilization of root C by alfalfa and chicory, both deep-rooting taprooted preceding crops, was determined. Methods: Three replicate plots of alfalfa and chicory grown on a Haplic Luvisol were 13CO2 pulse labeled after 110 days of growth. 13C was traced in plant biomass, rhizosphere, bulk soil and in microbial biomass after 1 and 40 days. C stocks and δ13C signature were quantified in 15 cm intervals down to 105 cm depth. Results: Alfalfa plant biomass was higher and root biomass was more homogeneously distributed between top- (0–30 cm) and subsoil (30–105 cm) compared to chicory. C input into subsoil by alfalfa, including roots and rhizodeposited C, was 8 times higher (3820 kg C ha−1) into subsoil compared to chicory after 150 days of growth. Microbial biomass in subsoil increased with alfalfa but decreased with chicory. Conclusions: Despite their general ability to build biopores, taprooted preceding crops differ in creating microbial hotspots in subsoil. Higher C input and microbial growth in subsoil under alfalfa cultivation can improve physico-chemical and biological properties, and so enhance root growth and consequently the water and nutrient uptake from subsoil compared to chicory.

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Keywords

13 CO pulse labeling 2, C input, Microbial hotspots, Plant-soil-microorganism interactions, Rhizosphere, Subsoil